The long & the short of it

Bird eggs are a rich source of food for a wide variety of predators, and the longer that eggs remain in the nest, the greater the chance of their being found and eaten. Because this time-dependent predation is typically high, birds are predicted to push the limits of their physiology to hatch their eggs in the shortest time possible. However, incubation periods vary widely among different species exposed to nest predators. For example, incubation periods among southern African songbirds vary from nine days in Grey-backed Sparrow-lark to twice this time in Wattle-eyed Flycatcher.

Some of this variation can be explained by differences in nest mortality risk: species that suffer high nest predation tend to have short incubation periods. This aside, however, the incubation period might be a trade-off with other physiological processes that are important for subsequent survival of the young. It has been proposed, for example, that longer incubation increases the number of cycles of stem-cell differentiation in the embryo, resulting in greater antibody diversity, and consequently leading to a more effective immune system throughout life. The latter might explain a general pattern of longer incubation in longer-lived species.

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The long-lived Cape Robin-Chat invests less effort in reproduction than many shorter-lived species.

An alternative view is that longer-lived birds invest less effort in incubation because the adults do not want to compromise their own survival. This reduced effort should translate into more interrupted incubation and lower incubation temperatures, leading to longer incubation periods.

Testing these various theories is a focus of research on the breeding bird community at Cape Town's Koeberg Nature Reserve, a collaborative venture between the Fitztitute and Professor Tom Martin at the University of Montana. To test the hypothesis that longer incubation strengthens the immune system among species, Penn Lloyd compared the skin swelling response (a measure of immune system strength) to a subcutaneous injection of a plant protein among 20 bird species. Surprisingly, the swelling response was less in species with longer incubation, the opposite of the predicted pattern.

Although it is intuitively obvious that the rate of embryo development is linked to incubation temperature, surprisingly little research has explored this relationship. To examine the influences of temperature on incubation period, Ron Bassar and Sonya Auer used temperature probes to measure the incubation temperatures of different species. This demonstrated a strong correlation between temperature and incubation period, with warmer eggs hatching sooner. To confirm this influence experimentally, they swapped eggs between species with high and low average incubation temperatures. When a Cape Robin-Chat egg (normally 16-day incubation) was incubated by a Cape Bulbul (normally 12-day incubation), its incubation period was shortened by nearly two days.

The influence of temperature on incubation was also supported by the pattern of seasonal variation in incubation period within the same species. Thus, early laid (late winter) eggs of Cape Robin-Chat have longer incubation periods than eggs laid in spring, when air temperatures are higher. The temperature probes showed why. Birds' eggs stop developing when their temperature falls below about 26 °C. In cold, wet weather, eggs cool down faster when the female is off the nest. Indeed, during cold-front storms, eggs can spend much of the day in arrested development, which lengthens the incubation period. Late-winter breeding must have some advantages, but at least some of its benefits are offset by the increased risk of losing eggs as a result of a longer incubation period. □

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